

The use of portable handheld devices is still in its infancy in airline MRO. The costs of installing the necessary hardware to make these devices function was initially high, but the advance of technology is making these systems more affordable and reliable.

# The application of handheld devices in MRO

**A**re wireless and handheld devices, which cut the technology strings in the hangar, stores and flight line to improve productivity and enhance safety and quality, a good investment or a waste of money? Opinions are still divided on this question, and the opportunities that future mobile computing technologies offer to airlines and maintenance repair and overhaul (MRO) shops are unclear.

## MRO technology at the wingtip

Many aviation MRO software vendors and even the original equipment manufacturers (OEMs) have been touting the benefits of bringing IT into the hangar and to the aircraft. In the early 1990s we saw the gradual introduction of standalone laptops loaded with compact discs (CD-ROMs) containing digital documentation for the aircraft were

gradually introduced, with the aim of reducing the time spent by mechanics walking to the library to consult maintenance manual references, illustrated parts catalogues (IPCs) or fault isolation manuals (FIMs). A part would be ordered only after the mechanic had looked up the technical data in the library, noted down the details, returned to stores and given the details to someone else to key into the computer system for review and part request. The procedure could take hours.

The obvious limitation to improving labour efficiency in this way was that all the laptops had to be updated with the latest version of the CD. Another drawback was the lack of real-time interaction with the central MRO system that controls everything from the aircraft technical records to ordering of parts.

Times have changed with the advent of affordable wireless local area network

(LAN) technology, commonly known as WiFi. Now the visions presented by the software vendors a decade ago look more realistic and practical. That is not the full story, however. A full mobile solution requires the removal of wires and the provision of light, portable hardware platforms that are usable in bright sunshine and have a long battery life. Above all, hardware providers have faced the challenge of producing devices sufficiently robust to withstand falls, rough treatment and spillages of nasty liquids.

The second element required for mobility is connectivity. This is linking the mobile hardware platform to a communications network to allow real-time interaction with the central database that is at the heart of the MRO system. We are all becoming familiar in our daily lives with mobile technology. Many of us are now used to personal digital assistants (PDAs), connecting to a wireless network or over a mobile telephone connection to collect e-mail. It is now commonplace to sign for a FedEx package on a PDA which validates over a mobile phone link. Mobile technology is all around us.

## Communications challenge

Delivery of mobile computing to the maintenance workforce presents a communications challenge for both airlines or maintenance providers. For high bandwidth connectivity to mobile devices, the standard WiFi



*Used widely in the military arena, the Itronix range of wireless toughened GoBook laptops are becoming popular in the airline MRO world. Lauda Air deployed the Boeing portable maintenance aid software on the GoBook.*

communications specification for most systems is IEEE 802.11b or 802.11g. This can now be installed in a hangar or stores environment, with various wireless hub points around the facility, for a relatively small capital outlay. Many airports are also installing WiFi as standard, providing some coverage at the gate. In general, 802.11b technology provides a wireless 'umbrella' of several hundred feet, the range decreasing if there are substantial structures in between the user and the wireless hub point. Inevitably, there will be 'dead spots' in the coverage in the hangar and certainly the signal will be significantly attenuated by the aircraft itself, making it difficult to provide coverage for mechanics working inside the aircraft. However, providing coverage in all areas, including the ramp, is more difficult with 802.11b and requires more investment.

Next generation WiFi technology provides worldwide inter-operability for microwave access known (WiMAX). This has an operational radius of 30 miles, solving some of the 'umbrella' issues of 802.11b. WiMAX also provides for shared data rates up to 70 megabytes per second. The only downside is that each WiMAX access point currently costs well over \$100,000, although the industry claims that this should drop to under \$30,000 within the next two years. WiMAX cards will be made available for standard notebook computers in 2006, while PDAs will only be able to use WiMAX in 2007.

Not all solutions rely on high bandwidth WiFi, however. Curtis Herbel, manager of maintenance programmes and Trax system at Champion Air uses Trax over CITRIX. "Data input and general navigation via a Citrix connection over a cheap cellphone data link work reasonably well. Results vary widely based on the quality of the connection. The biggest problem tends to be keystroke lag. The biggest uses for Trax on the road are defect entry, work order completion, work order pack prints, aircraft history queries, inventory checks and requisition creation and status. Printing from Trax via a Citrix connection over a cellphone data link to a mobile printer attached to a Panasonic Toughbook is a lengthy task for even small print jobs. Bandwidth and a reliable connection seem to be at the heart of the issue."

Deploying CITRIX technology can be extremely cost-efficient. Standard PDAs can be used to access applications remotely using standard cellphone technology from anywhere. "We even have one customer who uses a SATPHONE," says Chris Reed, managing director of Trax. "They fly the PDA with the aircraft to log minimum equipment lists (MELs) and order



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aircraft-on-ground (AOG) parts from the heart of Africa. The communications cost is astronomical, but if they only use it for a short time and it keeps the aircraft flying it is a simple return on investment."

### Hardware is key

Aircraft maintenance is a harsh operating environment for computer equipment. Mobile MRO solutions need

a light, tough, portable computing platform able to withstand a drop from an aircraft door, liquid spills, grease and dirt and temperatures anywhere from minus 20 to 50 degrees Celsius. It also needs to have a long battery life and screens that can be read in bright sunshine.

A favourite platform, used by vendors like Avexus and MIRO, is Xybernaut Atigo, which is a sturdy and light touch-screen tablet computer. Xybernaut has



The Panasonic CF-18 Toughbook converts from a traditional laptop into a wireless tablet with touchscreen. It is becoming a standard choice for wireless MRO deployment and electronic flightbags.

Another popular choice is the Panasonic Toughbook. Many mobile electronic flightbags (EFBs) use the CF18 model as a standard platform (see *Systems for air-to-ground communications, Aircraft Commerce, August/September 2005, page 42*). American Airlines has bought several hundred Toughbooks with GPRS cards to enhance its maintenance operation, and based the business case on time saved walking to and from the aircraft in search of data. These units cost about \$3,000 each, so the investment decision was not made lightly.

A brand that is used heavily in the military aircraft world is the Itronix GoBook. Used by the US Air Force, the GoBook is also used by airlines like Austria's Lauda Air for the Boeing portable maintenance aid (PMA) application. As well as being wireless-enabled, it can use an integrated GSM module to communicate over the internet.

Working closely with the hardware vendors is vital. MIRO Technologies is taking an integrated approach to support future customer implementation of wireless devices. "We have forged business relationships with both Intermec and Xybernaut Corporation," said Mark Ogren, vice president of commercial sales & marketing at MIRO Technologies. "A representative from Intermec presented at our most recent user group conference and we have been demonstrating the Xybernaut Atigo device running AuRA at several trade show exhibits in October. Our GOLD application provides radio frequency (RF) functionality for warehouse transactions via Intermec handheld devices for our aerospace and defence customers. This permits warehouse workers free access within their RF coverage area to perform standard material transactions."

### Sceptics remain numerous

Cimber Air Data from Denmark has been around for many years, and its AMICOS product is used by a number of airlines, particularly in Europe. "We see wireless as a natural extension of our product deployment," says Rune Hagan, new chief executive officer of Cimber Air Data. However, he is refreshingly blunt. "At present we only have one limited wireless deployment in the hangar. Also, we see that a full mobile solution would need some modification to be deployed



also pushed its wearable range of Mobile Assistant computers for aircraft maintenance, which has yet to catch on. "After a year-long trial at one of our US airlines, the customer handed back all of the Xybernaut mobile assistant hardware," admits Reed. "The cost to invest in this mobile hardware simply did not justify the benefits they got from it."

*MIRO Technologies is working alongside Intermec and others on enabling wireless working, particularly in the materials and stores areas of airlines.*

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on handheld PDAs. We have yet to do this work. There is also the issue of connectivity. At present, our solution needs full coverage, all the time, with the wireless device connecting directly to the central server; otherwise it will not work. We have not begun work to enable the application to store or cache data when it is disconnected from the network. We expect wireless to become common in the future, but the issue of regulatory approval of electronic signatures remains an issue for full adoption, and to enable the airline to get full benefit for the large investment in hardware and network technology."

Others agree with Hagan. A growing force in the world of MRO software is Swiss Aviation Software. Emerging out of Crossair, and then becoming part of Swiss, the software group is now a standalone division selling the AMOS product. Used by a number of European airlines, the Java-based internet-ready application has been around for a number of years. "Five years ago we started looking at wireless technology,"

says Ronald Schaeuffele, chief executive officer of Swiss Aviation Software. "We are yet to be convinced of the full usefulness of the technology. There are issues of usability, screen resolution and readability in all conditions in the hangar and on the line. Battery life remains limited. Mechanics are usually not the most careful with relatively fragile equipment. The cost of hardware support and upgrade is not cheap. And just how much does it really add to productivity?" Schaeuffele goes on to concede, however, that tablet technology is maturing and hardware resilience is becoming affordable. Swiss uses mainly Panasonic Toughbooks and it sees the first natural application in stores and material management. "Electronic signature is still the main issue for use of fully mobile, point-of-maintenance work recording. There is always a regulatory issue involved. However, for mechanics, browsing of technical documents does add value, and we now have a partnership with eDOC to provide this wireless integration for the shopfloor."

The Swiss application does not currently provide caching of data in a disconnected mode, and relies on the wireless network being 100% available for it to function. On the subject of radio frequency identification (RFID) tags, Schaeuffele is conservative. "It will take at least five years for RFID technology to mature for application in airlines."

### Real-life experience

Russell Adams is one of the mid-tier solution providers of integrated MRO systems, and has found that wireless is the norm in terms of deployment in the hangar. "The majority of our customers have deployed our systems using wireless networks," says Paul Boyd, managing director at Russell Adams. "The standard method tends to be a mobile workstation, with its own power supply and printer. It costs under £300 to install a standard 802.11b wireless system in a hangar. The PC can then be moved anywhere on the hangar floor to be used by the mechanics or supervisors, just like in a normal office. For stores, we have deployments on wireless Symbol handhelds which incorporate barcode readers. We also have some customers that occasionally use Panasonic Toughbooks to deploy with even more mobility. We would say that wireless should be a standard consideration for our customers. The system relies on the wireless coverage being total and continuous, however. If the network is not available, it will not work. Our view on RFID is that it will take several years before it is sufficiently practical and viable to add value to an MRO system. Yes it is good technology, but are the tags reliable, and is the technology mature?"

Even Reed at Trax remains sceptical. "Wireless at the wingtip is a dream for now," he says. "We have built several prototypes using Pocket Powerbuilder for non-routine card recording, but the issue is always that the end-user wants more and more data on small and limited display capacity PDAs. The issue is that the return on investment in expensive hardware is not great. Even RFID tags will take time to become inexpensive and have large enough memory. People tend to think that technology will solve more issues, more quickly than reality will allow."

RAMCO, from India, is more optimistic. It sees a range of applications for wireless technology. Namrata Ahuja, sales manager at RAMCO explains. "Mechanics in the hangar, on the shop floor, or at the line performing their day-to-day activities like work order reporting, task card signing and requesting for parts need instant access to the MRO software. Browsing technical documentation is a big productivity

enhancer. In the material department, personnel in warehouses and shipping areas use barcoded scanning of parts on PDAs to update stock levels in real-time while receiving goods, and even for physical inventory counting for stock taking. We also see future applications for operations and line maintenance crew using wireless enabled devices to constantly analyse the status messages sent from aircraft systems through the aircraft communication and reporting system (ACARS) to track faults and plan maintenance before the aircraft lands. In future wireless-enabled handheld devices will be used for reading maintenance data from RFID-tagged aircraft parts on board or on the shop floor."

Canadian-based MXi offers the Maintenix solution to airlines and military users. "The fact that our solution is web-based immediately makes it a mobile-ready solution," says Matt Tobin, vice president business development at MXi. "We have customers using our software over 802.11b networks, particularly in the military. NATO flying training in Canada has a 12-minute turnaround time on aircraft and uses truck-mounted laptops to access maintenance data. Glass 'real estate' is the biggest issue for mobile applications. Our system can recognise the device that is accessing it and build a compatible page for the screen that will view it, utilising web technology. Productivity gains can be significant, but digital signatures on work are what really unlock the value for customers. Then all the paper can be removed from the process and everything is electronically recorded at the point of maintenance. This is a regulatory issue, not a technological one."

### Staying mobile

Network coverage is one key issue that many vendors struggle to solve, with applications that are always on failing parts of the hangar. Avexus, from the US, takes a more advanced approach to this area of technology, offering mobility both connected and disconnected. "Avexus is focused on improving productivity in the hangar by eliminating non-value-added activities", says Rich Bergmann, president and chief executive officer at Avexus. "These are typically any manual repetitive tasks. We have thought carefully about an airline maintenance organisation, and looked at the separate issues of data collection and process execution based upon the data collected. What data is needed to be captured, when, where and how? Who needs it next? While mobile technology has a place in the modern workplace, we need to think carefully how and when it is used. We started to build a wireless



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portion of our application, but then realised what was needed was a point-of-work mobile solution. It seems like a subtle difference, but actually it is rather fundamental to the end result. It needs to be used all around and inside the aircraft. This last element results in an approach that does not require an 'always-on' network. Sometimes wireless coverage is lost and we do not want the mobile solution to grind to a halt. This means storage on the handheld parts of the

database."

The Avexus approach overcomes some of the issues of other solutions, but carries with it a host of other questions. How are the data validated on the handheld device if they are not connected to the central database? How much data can be stored on each handheld device? What happens if all the data are not fully synchronised back with the central server? What happens if several handheld devices are trying to update the same part



of the database at the same time? “We overcome some of these issues by downloading parts of the database locally, for example the aircraft technical logbook with all the installed components including serial numbers,” answers Ari Master, director of business development at Avexus. “But it is not easy. It has taken us years to evolve the current technology for synchronisation. Hardware is evolving all the time and assisting us in this process.” Avexus sees the development of the user interface as a crucial part of making the solution work effectively and pay for the investment. “There is only a limited amount of ‘glass real estate’ on the PDA or mobile tablet computer,” points out Masters. “This means that the graphic user interface (GUI) needs to evolve towards a guided process, walking the mechanic through the data fields and action buttons in a logical, easy-to-follow sequence. Our GUI for the mobile solution can be rapidly modified and simplified if necessary.”

### A new solution

A different approach to mobile MRO solutions is taken by US-based Perceptive Inc. “Wireless is not the ‘silver bullet’ for productivity improvement that many airlines believe or hope it is,” says Ray Andrick, chief executive officer of Perceptive. “Many vendors and customers mistakenly view wireless deployment of software just like a cabled network deployment, just with the wires removed. I have seen many bad approaches to this whole area of MRO

software. The classic is that many MRO software suppliers simply put their office-based applications on a wireless tablet. Now they expect mechanics and stores personnel to interact with a screen that was built for a keyboard, without actually having a keyboard! It does not make sense. Having said that, access to a mobile device can aid a couple of tasks in a maintenance hangar. The most natural fit from a process point of view is the non-routine card (NRC) management task. About 50% of hangar work is unscheduled, unexpected non-routine work emerging from a scheduled, known inspection task. The scheduled work content is already known: parts, labour skills, man-hours, and manual references are all predictable and can be planned ahead of time. Completion of work on an NRC requires several things to happen, including analysis of the work that needs to be performed, the parts needed to complete it, the recording of findings and so on. This is usually done on paper and then handed in for someone to type it into the MRO system and create part requests, which can take literally days from the time the mechanic created the need for the NRC to the data entry. This happens on half of the work content for an aircraft check. This is a big opportunity to cut wasted time.”

Perceptive has created a specific tool for the mechanics to use. RedStone is tailored around the NRC workflow, with a specific easy-to-use graphical interface (GUI). Although it is platform-independent, it is usually deployed on a toughened PDA running MS Windows

*Perceptive Inc has deployed the RedStone non-routine card solution. Working on standard wireless PDAs, it can cope with losing the network link when mechanics are inside the aircraft.*

Pocket PC. The two most popular suppliers are Intermec and Symbol and include integrated barcode readers.

A key point about the RedStone system is that the PDA runs a piece of client software on each PDA. The desktop element of the system, which runs on a normal LAN PC, is web-based.

“Client-installed software for the PDA it is an important element of the overall solution. The system is expecting not to have a connection to the central server or other software systems most of the time,” explains Andrick. “Data from the NRC process is stored locally on the PDA and when wireless connectivity is made, the unit synchronises with the central database. Normally if a mechanic is working around or inside the aircraft, the wireless umbrella will be broken periodically. It is no good if the mobile application needs to have the connection on all the time, which is another reason why some ERP vendor solutions, deployed on wireless tablets, will never work.” The results support Andrick’s comments. Frontier Airlines, based in Denver, deployed Perceptive’s NRC solution recently and the quantitative results are impressive. According to Frontier, time spent on inspection and evaluation to create non-routine work orders was reduced by 80%. For every 400 non-routines created, 6,000 potential man-hours are saved. Implementing the handheld devices to create non-routines also helped cut two days downtime from a routine C check.

The bottom line is always money-related. The return on investment for the handheld project was satisfied on Frontier’s second C check which yielded a saving of three days downtime. A key element to the NRC handheld solution is, however, that it cannot operate effectively in isolation. The solution must be integrated with the MRO systems for technical records, overall work package management, material management and so on. “We have built our solution with this challenge in mind,” says Andrick. “We integrate using XML, and in fact ‘wrapper’ our interface around the ERP/MRO software vendor’s system with ours to ease the mechanic’s interaction with the computer. The mechanics are not even aware that they are interfacing with some unfriendly ERP software system.

The future developments are about bandwidth, response times, processing power and technologies like RFID tags on parts to improve error rates even further on data entry.”

## Manufacturers enter

So what of the OEMs? In the early days, they were the evangelists of mobile working. Boeing has had the Portable Maintenance Aid (PMA) for a number of years, working largely on the principle of locally loaded data and CDs with the reference data and applications stored. The latest offering is the Maintenance Performance Toolbox (MPT), offering all the features of the PMA plus much more. “The MPT is like a stretched PMA,” claims Barth Poage at Boeing. “We have extended the PMA and added role-specific functionality, with new tools to access advanced documentation and graphical representations of the aircraft intelligently. The aim is to cut down wasted research time for the mechanic. For example, documents for a line replaceable unit (LRU) are specific to that ‘box’, and link the AMM, IPC and FIM together with 3-D views of the unit in situ. It also links task information, limitations, repair data and even videos of removing and installing the unit.” The MPT is very impressive in action. Boeing is adding taskcard creation and printing, together with the ability to author the task and job cards with links to the AMM references. The PMT does need an internet connection to function, and therefore needs the wireless umbrella to be present. But it does have some backup capability for documentation on CDs locally installed on the laptop. For MRO systems, integration is through application public interfaces (APIs). Currently this includes integration with SAP and MXi.

## The future

The next step forward in mobility seems to be RFID tags. Almost all the software vendors put this as the next technological leap forward. These devices are used in many other industries, for example in military aviation to track part identification and history data. Passive RFID tags emit simple static data about part and serial numbers to enable a mobile MRO system to sense and identify the item without the user needing to interact with the software. More interestingly, OEMs are discussing active read-write RFID tags that can store dynamic data about components. For example, the tag could hold the modification status, maintenance tasks due, and other engineering data. The MRO system could interact and update the tag when work is performed on the

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item, and recorded in the MRO software. This dynamic tag would need to carry a larger memory capacity, which would drive up the cost. As the price of memory continues to fall, these tags will become commonplace.

## A good investment?

It is clear that wireless networks can provide some benefits, but many operators still find it difficult to justify the

investment. Some vendors take a very simplistic view of their use and have yet to really tackle the issue of network connectivity not being available 100% of the time. Some niche solutions, like Perceptive Inc's Redstone, can enhance and complement a full MRO solution in the hangar and provide significant improvements. Hardware will remain one of the keys to fully unlocking the mobile world for MRO, and the price will undoubtedly continue to fall. **AC**